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COMPUTER FULL TEXT

(54) Unresolved hyperlinks containing queries for interrogating databases of resolved hyperlinks

(57) A hypermedia-based navigation system includes a plurality of information providers and one or more clients. Databases of available hyperlink targets are maintained by the information providers. Each of the databases is searchable by means of one or more query attributes supported by the database and relating to the available hyperlink targets. A hypermedia document might contain a soft hyperlink, consisting of a query formulation specified in terms of query attributes and of values for said query attributes. A client resolves a soft hyperlink by querying at least one of the databases with the query formulation to locate one or more hyperlink targets having attributes and attribute values that satisfy the query formulation. The soft hyperlink can additionally contain executable rules. The client executes these rules prior to submitting the query formulation to the database. Each rule, when it executes, potentially adds search predicates to the original query formulation. Execution of a particular rule is conditioned upon a set of mandatory attributes associated with the rule. The rule will be executed if and only if its mandatory attributes are bound to actual values by the particular client attempting to resolve the soft hyperlink.

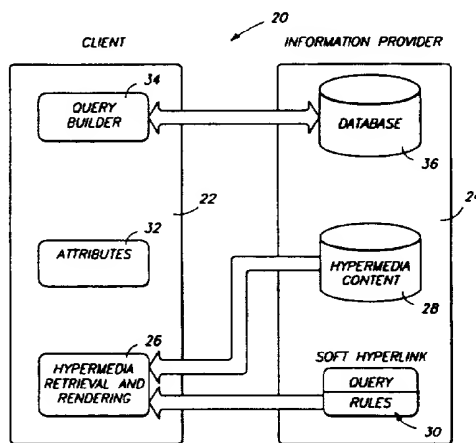
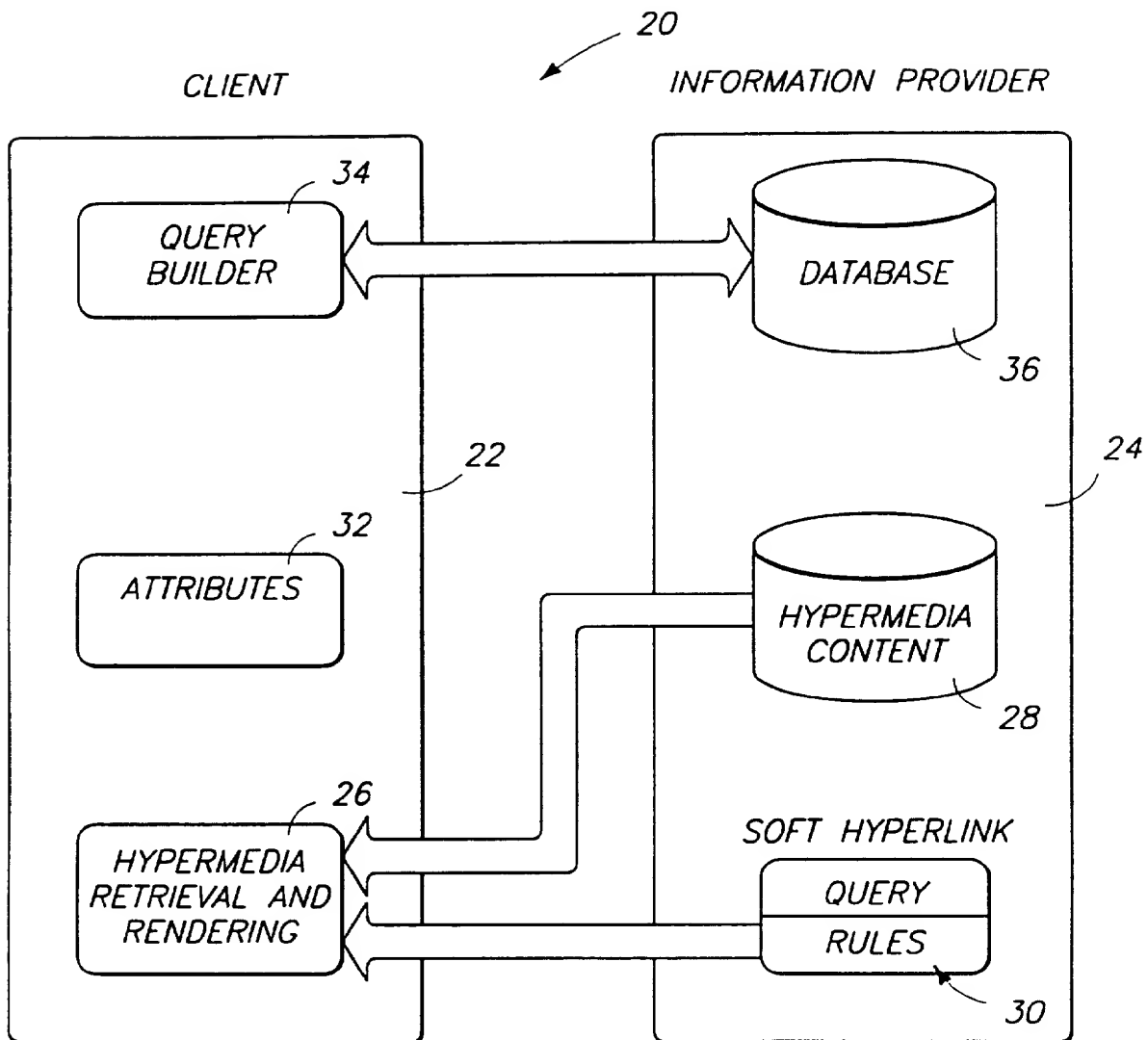


Fig. 1

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*Fig 1*

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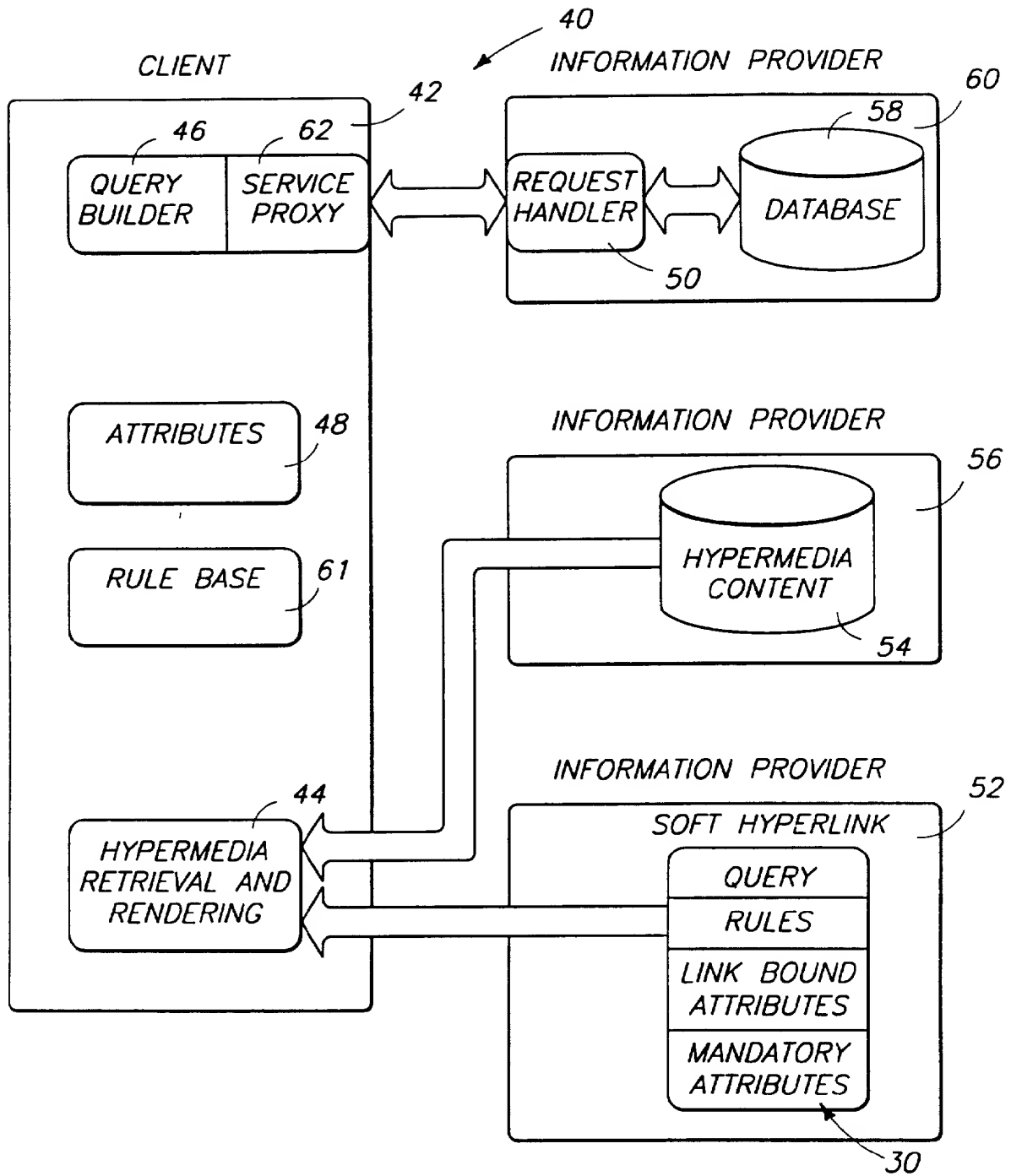
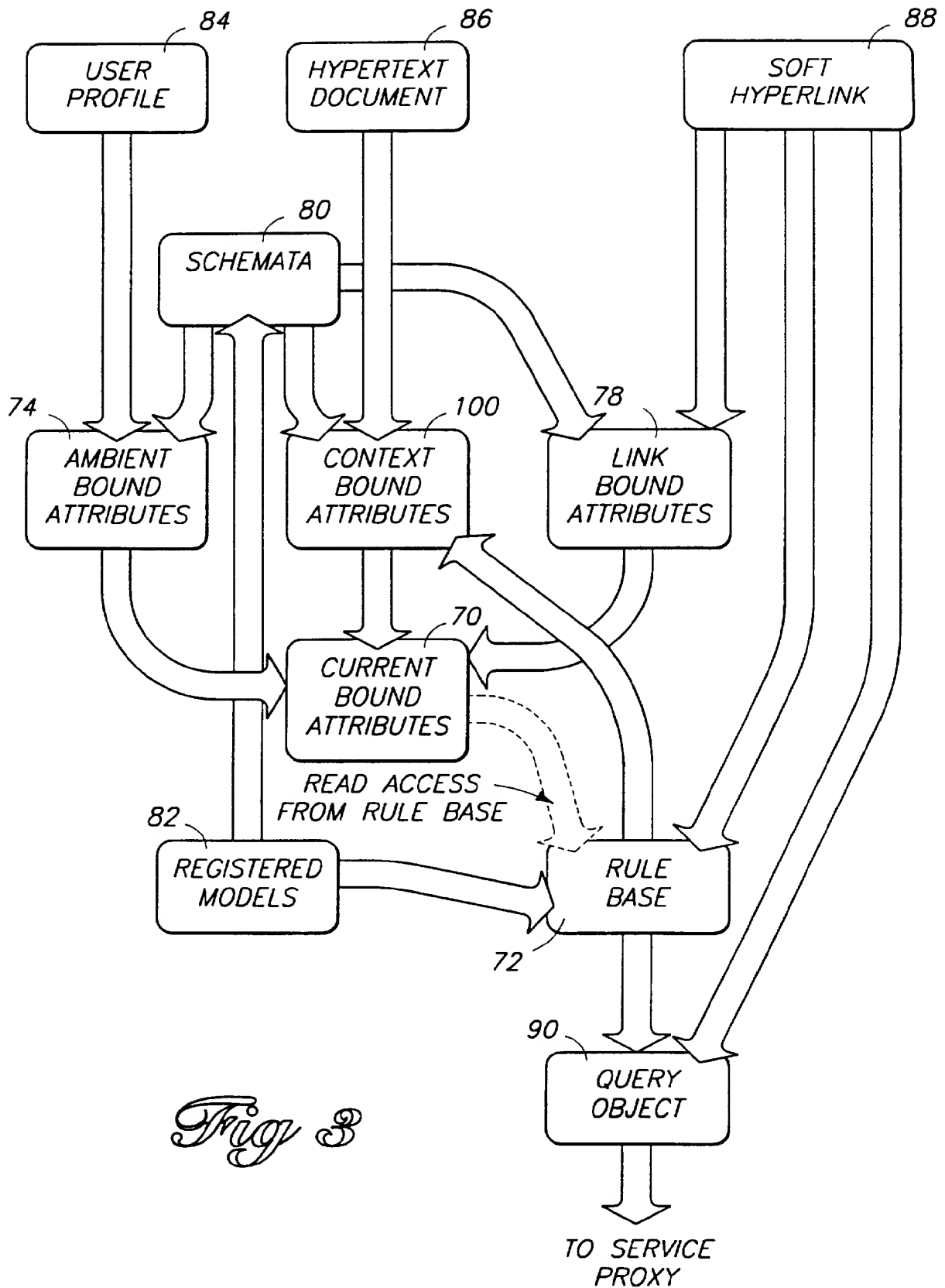
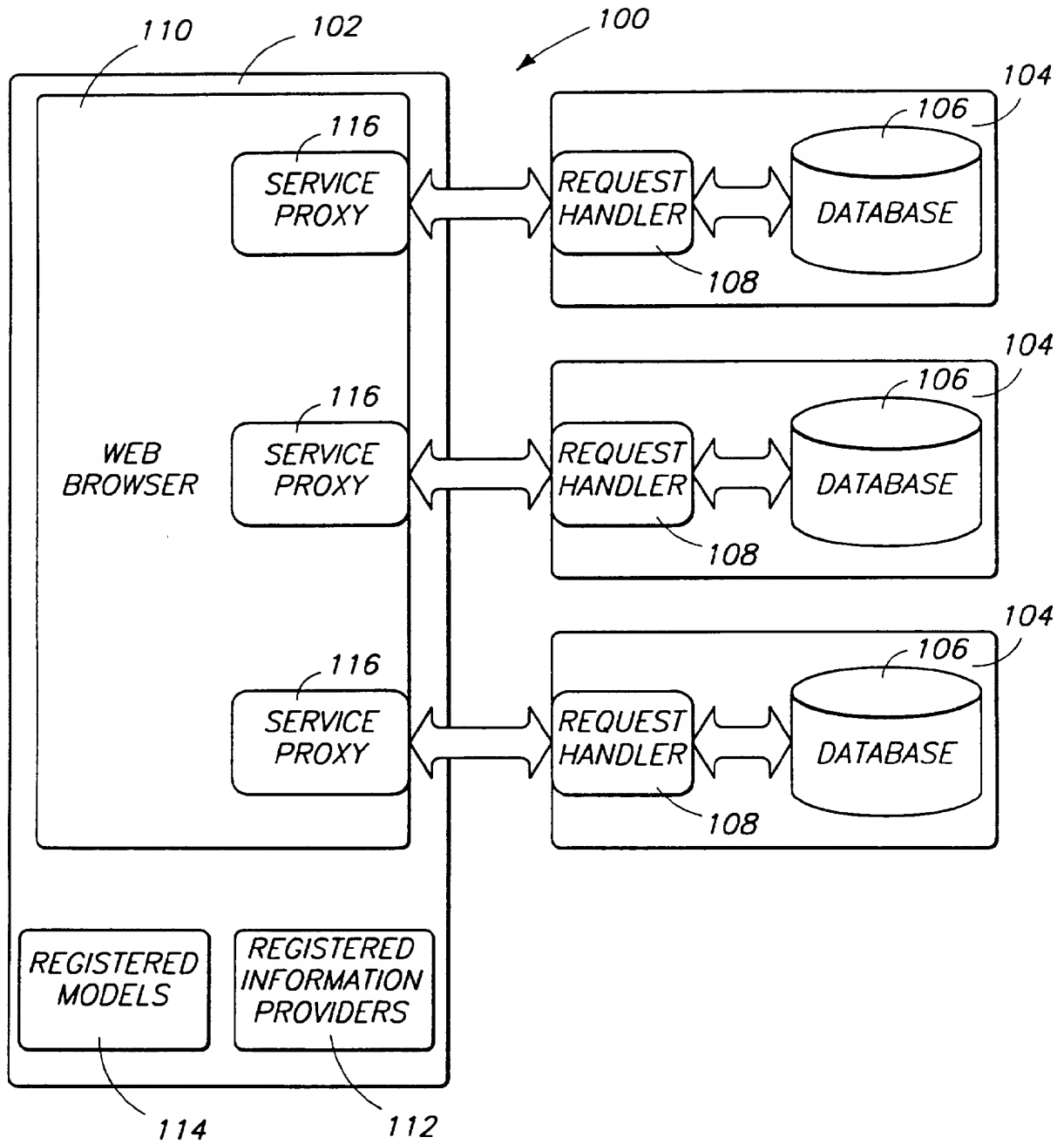


Fig 2

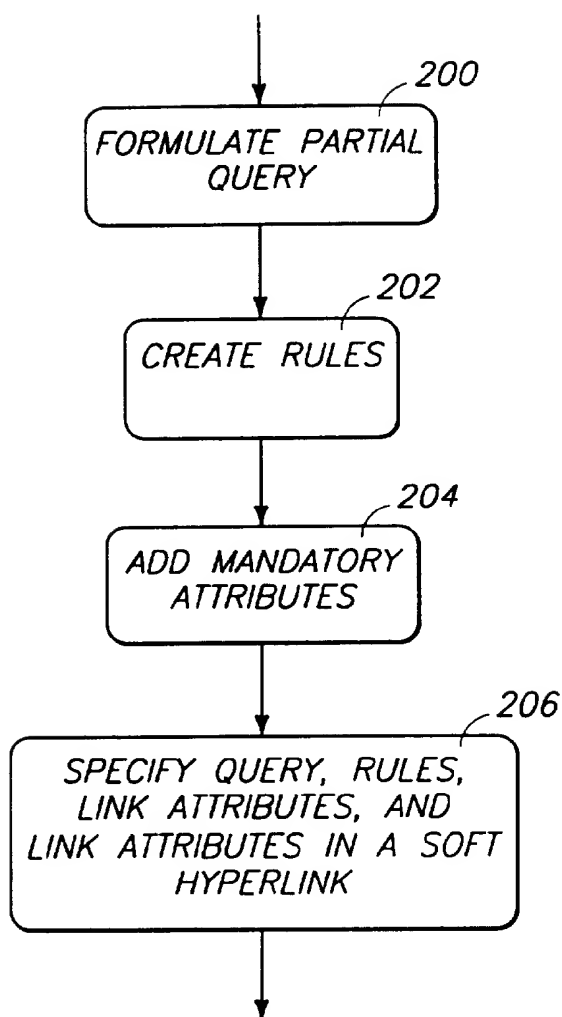
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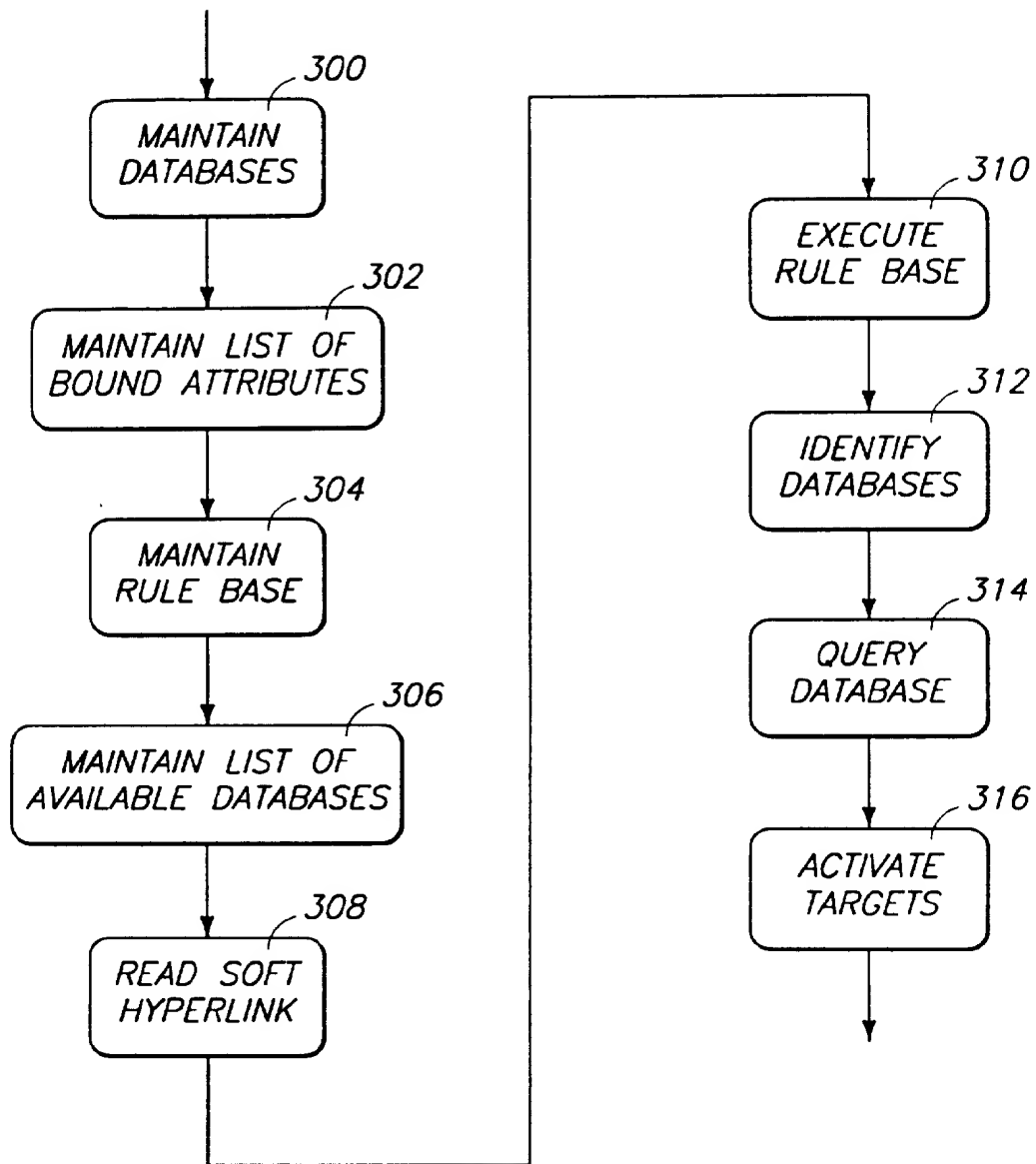
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*Fig 4*

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*Fig 5*

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*Fig 6*

1 **TECHNICAL FIELD**

2 This invention relates to hypermedia and hypermedia navigation.

3
4 **BACKGROUND OF THE INVENTION**

5 "Hypermedia" is a metaphor for presenting information in which text,
6 images, sounds, and actions become linked together in a complex, non-sequential
7 web of associations that permit a user to browse through related topics, regardless
8 of the presented order of the topics. Hypermedia arises from "hypertext," a term
9 which was originally coined to describe text-based documents including links to
10 other such documents to form a non-sequential web of associated ideas.

11 Hypermedia content is widely used for navigation and information
12 dissemination on the "World-Wide Web" (WWW or Web) of the Internet. An
13 application program referred to as a "Web browser" is normally used to retrieve
14 and render hypermedia content from the WWW.

15 Hypermedia content is commonly organized as documents with embedded
16 control information. The embedded control information includes formatting
17 specifications, indicating how a document is to be rendered by the Web browser.
18 In addition, such control information can include links or "hyperlinks": symbols or
19 instructions telling the Web browser where to find other related WWW documents
20 on the Internet. A hyperlink from one hypermedia topic to another is normally
21 established by the author of a hypermedia document, although some applications
22 allow users to insert hyperlinks to desired topics.

23 A hyperlink is typically rendered by a Web browser as a graphical icon or
24 as highlighted keywords. A user "activates" or "follows" a hyperlink by clicking
25 on or otherwise selecting the icon or highlighted keywords. Activating a link

1 causes the Web browser to retrieve and render the document or resource that is
2 targeted by the hyperlink.

3 Associated with a hyperlink's icon or highlighted keywords is an
4 underlying target specification. The target specification is set forth in the
5 underlying hypermedia document, but is normally invisible to the user. The target
6 specification unambiguously identifies a targeted document or resource, typically
7 specifying the name of the computer on which the document resides and the
8 complete file name of the document. In WWW documents, targets are specified
9 using "uniform resource locators" (URLs). A URL describes everything about a
10 particular resource that a Web browser needs to know to request and render it. The
11 URL describes the protocol a browser should use to retrieve the resource, the name
12 of the computer it is on, and the path and file name of the resource.

13 Hypermedia content utilized by the WWW is commonly written using what
14 is referred to as a "markup language." "SGML" (Standard Generalized Markup
15 Language) is one such language, defined formally as "a language for document
16 representation that formalizes markup and frees it of system and processing
17 dependencies." SGML is a language for describing the structure of documents and
18 for describing a tagging scheme to delineate that structure within text.

19 For creating hypermedia content, WWW documents utilize a specialization
20 of SGML called "HTML" (Hypertext Markup Language). An HTML textual
21 document can be thought of as plain text that contains formatting instructions in
22 the form of HTML markup codes or "tags." Tags tell Web browsers how to render
23 and print documents, and are also used to specify hyperlinks.

24 The following is a simple example of a short hypertext document
25 containing a single hyperlink:

1 Microsoft has a Web page with the latest
2
3 upgrades to its popular word processing
4 program.

5 In this example, the word "upgrades" would appear highlighted to the user,
6 and the text within the angled brackets would not appear at all:

7 Microsoft has a Web page with the latest upgrades
8 to its popular word processing program.

9 By clicking on the highlighted keyword "upgrades," the user can instruct
10 the Web browser to activate the underlying target specification. In this case, the
11 underlying target specification is to an HTTP (HyperText Transport Protocol)
12 document located at computer "www.microsoft.com," having the file name
13 "upgrades."

14 The angled brackets in the example define hypertext tags. In most cases,
15 tags occur in pairs: a start tag and an end tag. The start tag indicates where a
16 particular formatting is to begin, and a corresponding end tag indicates where the
17 formatting is to end. A start tag begins with a code (after the leading angled
18 bracket) indicating a tag type. An end tag consists of that same code, preceded by
19 a forward slash.

20 In the example above, the leading "A" in the start tag indicates that it is an
21 "anchor" tag—the type of tag that defines a hyperlink. The start tag contains a tag
22 "attribute," indicating a target specification:
23 HREF="HTTP://www.microsoft.com/upgrades".

24 In concept, the target of a hyperlink can be virtually any type of object—
25 including executable programs, text or multimedia documents, sound clips, audio
26 segments, still images, computers, directories, and other hyperlinks. In WWW
27 documents, hyperlink targets are most often files that can reside on any computers

1 connected to the Internet. However, a hyperlink target can also be a particular
2 location within a document, including the document that is currently being
3 rendered.

4 Hypertext usage is not limited to the Internet. Various multimedia
5 applications utilize hypertext to allow users to navigate through different pieces of
6 information content. For instance, an encyclopedia program might use hyperlinks
7 to provide cross-references to related articles within an electronic encyclopedia.
8 The same program might also use hyperlinks to specify remote information
9 resources such as WWW documents located on different computers.

10 Although the concept of hyperlinks adds incredible interest and
11 convenience to many applications such as WWW browsers, navigating through
12 vast quantities of information requires significant input by a user. Consider, for
13 example, the theoretical problem of using an information resource such as the
14 WWW to find an appropriate restaurant for dining in the Seattle area. Suppose
15 further that a great many restaurants in the Seattle area have informative Web
16 pages (possibly including complete menus and prices) on the Internet.

17 To make any use of these Web pages, it is first necessary to find them.
18 Assuming their URLs are available in some type of address book, it might still be a
19 daunting task to manually enter the URLs and to examine the Web pages of a large
20 number of restaurants. Fortunately, there are some available tools which might
21 facilitate or automate some of this process. For instance, a user might make use of
22 an available search engine and associated database to perform a search based on
23 certain key words. A search engine such as this might return a formatted
24 document or directory having hyperlinks to the Web pages found as a result of the
25 search. Alternatively, a lucky user might find a Web page directory that already

1 lists hyperlinks to the Web pages of Seattle restaurants. An even luckier user
2 might find a Web page having hyperlinks to Seattle restaurant Web pages,
3 categorized by type of cuisine.

4 While these prior art methods are somewhat workable, frequent users of the
5 WWW realize that they are often unreliable and nearly always time-consuming.
6 Specifying an appropriate search query for a search engine, for instance, is not
7 always simple and does not always result in the desired results. Similarly, just
8 finding a Web page directory of desired information is often very difficult and
9 time-consuming. Furthermore, the information listed in the directory is often
10 incomplete, out of date, or not categorized in a way that the user finds useful.
11 Quite often, the only way to find current information is to actually examine a great
12 many WWW documents, on a hit-or-miss basis, until an appropriate document or
13 resource is found. This can waste a great deal of time.

14 The inventors believe that there is a better way of directing users to desired
15 information.

16 17 **SUMMARY OF THE INVENTION**

18 The invention utilizes what will be referred to herein as "soft" hyperlinks.
19 A soft hyperlink is a link that is not fully resolved when it is written. Further
20 information is required to identify the ultimate target of the hyperlink.

21 The inventors have defined a hypermedia navigation system that allows
22 hyperlinks to specify hyperlink targets that can be resolved in a way that is
23 dependent on characteristics and preferences of a particular user. To be
24 compatible with the navigation system, information providers maintain databases
25 of available hyperlink targets. Each database supports a set of attributes, and

1 stores appropriate attribute values for each hyperlink target. For instance, a
2 database might support an attribute indicating the reading level required to
3 understand target content, and another attribute indicating the general nature of the
4 target content (fiction/non-fiction). Values for these attributes would be stored in
5 the database for each available hyperlink target.

6 A user's computer maintains similar information relating to the user, to the
7 user's computer and system, and to the world in general. This information is
8 categorized in terms of attributes—similar or identical to the attributes used by the
9 databases. The computer maintains a list of bound attributes—attributes that have
10 values. These attributes include "ambient" attributes having values that are
11 specified independently of hypermedia content. They also include "link" attributes
12 that are specified in a selected hyperlink. Furthermore, the list of bound attributes
13 might include "context" attributes that are specified in a currently-rendered
14 hypermedia document. The ambient attributes are relatively permanent, while the
15 link and context attributes change as the user navigates between and within
16 documents.

17 The user's computer also maintains a list of available databases, along with
18 the different attributes supported by the respective databases.

19 A "soft" hyperlink, as used herein, comprises a partially-specified query
20 rather than a conventional target specification. The query is expressed in terms of
21 attributes supported by the databases. The soft hyperlink also contains one or
22 more executable rules. The purpose of the rules is to add further search predicates
23 to the query. In addition, a soft hyperlink can contain a specification of bound
24 attributes for temporary inclusion in the list of bound attributes maintained by the
25 user's computer.

1 To resolve a soft hyperlink, an application such as a Web browser identifies
2 and extracts the partially-specified query from the hyperlink along with the rules
3 and link attributes specified in the hyperlink. Each rule is associated with a set of
4 mandatory attributes that are also specified in the hyperlink. The Web browser
5 executes each rule if and only if its associated mandatory attributes are found in
6 the computer's list of bound attributes. During execution, a rule examines the list
7 of bound attributes and potentially adds search predicates to the query, depending
8 on the values of the bound attributes.

9 After all the appropriate rules have executed, the query is submitted to one
10 or more appropriate databases. The appropriate databases are selected based on
11 whether they support the attributes ultimately specified in the query. The
12 database(s) return one or more hyperlink targets, in the form of target
13 specifications. If only one target is returned, that target is activated automatically
14 (the targeted document is retrieved and rendered). If more than one target is
15 returned, the choices are rendered as hyperlinks, and the user can choose which of
16 them to activate.

17 To introduce a measure of uniformity into the system, attributes are
18 organized into different schemata. Each schema defines a number of semantically
19 related attributes. Rather than keeping track of the individual attributes supported
20 by a database, the user's computer actually tracks which schemata are supported by
21 each database.

22 Schemata are further organized under different models, such as user
23 models, device models, business models, world models, etc. Different models are
24 registered with a particular computer. Any model can specify its own rules.
25 "Ambient" rules from the models and "link" rules from a selected hyperlink are

1 combined in a rule base and executed individually as appropriate according to
2 whether their mandatory attributes are bound and present in the list of bound
3 attributes.

4 5 **BRIEF DESCRIPTION OF THE DRAWINGS**

6 Fig. 1 is a block diagram of a hypermedia-based navigation system in
7 accordance with a simplified embodiment of the invention.

8 Fig. 2 is a block diagram of a hypermedia-based navigation system in
9 accordance with a more complex embodiment of the invention.

10 Fig. 3 is a block diagram showing various logical elements of the
11 navigation system of Fig. 2.

12 Fig. 4 is a block diagram showing additional features of a navigation system
13 such as shown in Fig. 2.

14 Fig. 5 is a flow chart showing methodological steps of specifying a
15 hyperlink in accordance with the invention.

16 Fig. 6 is a flow chart showing methodological steps of resolving a hyperlink
17 in accordance with the invention.

18 19 **DETAILED DESCRIPTION**

20 Fig. 1 is a representation of a hypermedia-based navigation system in
21 accordance with a simplified embodiment of the invention, generally designated
22 by reference numeral 20. System 20 includes a client 22, preferably comprising a
23 personal computer or other hypermedia selection, retrieval, and rendering device.

24 System 20 includes an information provider 24 that provides hypermedia
25 documents to client 22 through conventional communication channels and

1 protocols such as the Internet or another wide-area or local-area network or some
2 other type of information distribution media.

3 Client 22 includes conventional hypermedia retrieval and rendering
4 software 26 for retrieving hypermedia content from information provider 24 and
5 for rendering it in accordance with conventional HTML instructions. Software 26
6 resides on a computer-readable storage medium such as a magnetic storage or
7 electronic randomly-addressable memory, programmed in accordance with steps
8 that will be further described below. This software understands conventional
9 "hard" hyperlinks, and is capable of retrieving or navigating to hypermedia
10 documents or resources specified as targets in such hard hyperlinks. A hard
11 hyperlink is one containing a completely resolved target specification. A
12 conventional HTML hyperlink is an example of a hard hyperlink.

13 In addition, client 22 is capable of resolving "soft" hyperlinks. A soft
14 hyperlink is one which does not contain a resolved target specification. Rather, a
15 soft hyperlink specifies elements that enable client 22 to resolve the hyperlink
16 when it is activated, based on variable factors.

17 Information provider 24 contains hypermedia content 28, in the form of a
18 number of computer-readable hypermedia documents or files. These documents
19 include information content for display or rendering to a user. Any of these
20 documents potentially contains soft hyperlinks, an example of which is shown as
21 soft hyperlink 30. Hyperlink 30 can be activated by the user in a conventional
22 manner when the associated informational material is displayed.

23 Generally, client 22 obtains and displays a hypermedia document that
24 includes a list of one or more soft hyperlinks. In response to the user activating
25 one of the soft hyperlinks, a query is performed for one or more hypermedia

1 targets. Rather than requesting search limitations from the user, the query is
2 formulated using attributes associated with the user, attributes specified in the
3 hypermedia document, and attributes specified in the activated soft hyperlink. As
4 a result of the query, client 22 displays a list of the hypermedia targets in the form
5 of further hyperlinks, possibly including both soft and hard hyperlinks.

6 As shown in Fig. 1, soft hyperlink 30 contains or is associated with a query
7 formulation and one or more executable rules for potentially adding search
8 predicates to the query formulation. It does not contain a conventional target
9 specification such as a URL designation.

10 The query formulation of soft hyperlink 30 is specified at least partially in
11 terms of query attributes and of values for the specified query attributes. A query
12 attribute and a corresponding value describe some characteristic of a hypermedia
13 target. For instance, a query attribute might indicate the type of cuisine featured in
14 a particular hypermedia document.

15 Client 22 maintains a list of bound user attributes 32. In the simplified
16 example of Fig. 1, these attributes describe characteristics and preferences of a
17 particular user, preferably based on a user profile that can be edited by the user.
18 The bound user attributes might indicate, for example, the geographic location of
19 the user, his or her age, dining preferences, and numerous other things.

20 Client 22 includes a query builder 34. The purpose of query builder 34 is to
21 formulate a query that will identify a hyperlink target based on the information
22 from soft hyperlink 30 and the user attributes in the list of bound user attributes 32.
23 The query builder starts with the query formulation specified in soft hyperlink 30.
24 It then executes the rules specified in soft hyperlink 30 and other rules potentially
25 specified within client 22. The purpose of each rule is to further refine the query

1 formulation by adding search predicates or query fragments to the original query
2 formulation. In order to decide how to refine the query, a rule examines the list of
3 bound user attributes 32. This allows the rule to customize the query based on user
4 characteristics and preferences. After all the rules have executed, the query is
5 submitted to a database 36 for identification of possible hyperlink targets meeting
6 the search criteria.

7 Information provider 24 maintains database 36 to accept queries formulated
8 in terms of the query attributes described above. In response to a query, database
9 36 returns a list of hyperlink targets that meet the search criteria. These targets are
10 typically specified as hard hyperlinks, although database 36 might also return one
11 or more soft hyperlinks. The returned target specifications might be to resources
12 within the content 28 of the information provider itself, or might be to content
13 provided by other information providers. Client 22 lists these targets for the user,
14 and the user can activate one of the targets by selecting it. If only one target is
15 returned, client 22 might activate it without further input from the user.

16 Consider again the example of a user who wants to find a restaurant for an
17 evening's meal. The user first needs to find a soft hyperlink that identifies
18 "restaurants" as its topic. Suppose that the author of the soft hyperlink intended it
19 to direct the user only to restaurants meeting the user's particular preferences.
20 Thus, the query formulation in the hyperlink specifies only that the results of the
21 query should be limited to restaurants. However, the author also specifies several
22 executable rules in the query. These rules examine the user's list of bound
23 attributes to determine location, cuisine preferences, and other information that
24 might help narrow the choices of available restaurants. After looking at the user's
25 bound attributes, the rules add appropriate search predicates to the original query

1 formulation. The query is then submitted to the database, which returns a list of
2 hard links to web pages of restaurants that closely parallel the user's preferences
3 and characteristics. As a more specific example, specified rules might attempt to
4 tailor the search query to the user's age. If the user was under 16 years old, a rule
5 might add search predicates limiting the query to fast food restaurants within a
6 short distance of the user's geographical location. If the user was a senior citizen,
7 a rule might add search predicates limiting the query to restaurants offering
8 discounts to senior citizens.

9 Since the list of bound attributes will vary with each user, two different
10 users will possibly be directed to different targets, even though they have selected
11 the same soft hyperlink.

12 The list of bound attributes is derived primarily from a user profile. The
13 user enters this information on an input screen or window that is formatted
14 conveniently for manual data input. The user profile might include many different
15 items of information, such as name, age, reading level, geographical information,
16 types of available transportation, income, spending habits, etc. The list of bound
17 attributes can also contain entries that are based on information gathered
18 automatically from the user's computer, such as various characteristics of the
19 computer itself. In some cases, it might be possible to automatically gather some
20 information about the user.

21 Fig. 2 shows a representation of a hypermedia-based navigation system in
22 accordance with a preferred embodiment of the invention, generally designated by
23 reference numeral 40. System 40 is similar in many respects to system 20 of Fig.
24 1, including a client 42 with a hypermedia retrieval and rendering component 44, a
25 query builder 46, and a list of bound attributes 48. In this case, client 42 is

1 connected over one or more network communication paths to communicate with
2 several different information or service providers. A soft hyperlink 50 is contained
3 in a document from a first information provider 52; various hypermedia content 54
4 is available from a second information provider 56, and a database 58 of available
5 hyperlink targets is maintained by a third information provider 60 (similar to
6 database 36 of Fig. 1).

7 The operation of system 40 is similar to that of system 20 of Fig. 1, with a
8 few additional elements. First, note that client 42 maintains a "rule base" 61. This
9 is a list of rules that are to be executed by query builder 46 prior to submitting a
10 query to database 58. Many of these rules come from a currently-selected soft
11 hyperlink, as described above with reference to Fig. 1. However, the rule base can
12 also contain rules that are specified independently of any particular soft hyperlink.
13 Such "ambient" rules can be specified, for instance, by a user or by an application
14 running on the user's computer.

15 Note also that soft hyperlink 50 contains two new elements: "link bound
16 attributes" and "mandatory attributes." Link bound attributes are attribute and
17 value pairs that are to be added to the user's bound attribute list before execution
18 of the executable rules relating to the soft hyperlink. Mandatory attributes are
19 unbound attributes that are associated with each executable rule specified in the
20 soft hyperlink. A particular rule is allowed to execute if and only if its mandatory
21 attributes are present and bound in the user's bound attribute list.

22 A further feature of system 40 is that queries are passed to the database
23 through a "service proxy" 62. A service proxy is associated with each different
24 information provider that provides a searchable database. The service proxy is an
25

1 executable program or programming interface that resides and executes on client
2 42.

3 The primary responsibility of the service proxy is to translate a query into a
4 format that will be understood by the information provider, and to send the
5 translated query to the information provider. A corresponding "request handler"
6 64 at the information provider receives the query and either executes it against
7 database 58 or submits it to a database server.

8 In the preferred embodiment, query builder 46 formulates a query that is
9 similar or identical to an SQL (Structured Query Language) query. The service
10 proxy translates the query from this standard language into a language that its
11 information provider can understand. It is useful to incorporate a macro interpreter
12 in the service proxy so that a variable can be expressed in a search query in general
13 terms rather than as a specific value. Some search criteria may be best specified in
14 relative terms rather than absolute terms—such as whether a restaurant is
15 "expensive." Different information providers might have different concepts of
16 what constitutes an "expensive" restaurant. With a macro interpreter, a search
17 query can be formulated to specify, for instance, that search results should be
18 limited to restaurants that are "moderately expensive." The service proxy for each
19 information provider will interpret this differently, and will submit a query to the
20 information provider in appropriately concrete terms.

21 Fig. 3 illustrates the logical organization of rules and attributes in the
22 preferred embodiment of the invention. Rules and attributes are organized and
23 managed under a general heading of "models." A model is an abstract
24 representation of knowledge about a particular domain and the reasoning that takes
25 place over that knowledge. For example, one model (a "user" model) might

1 contain information about a user (e.g., name, location, likes, dislikes, patterns of
2 behavior, etc.) as well as "rules" that dictate how to manipulate and combine that
3 information in interesting and beneficial real-world ways. A model is preferably
4 limited to one real-world concept or domain. The user domain is one example.
5 Other examples include "device," "business," and "world" domains. A device
6 domain includes information about a client or server device. A business domain
7 includes information relating to businesses. A world domain includes information
8 that is globally true, such as conversion factors, laws of nature, etc.

9 A model is organized as one or more schemata. A schema defines a
10 number of related attributes. Within a model, an attribute is merely defined; it is
11 not assigned any particular value. However, at some point the model is applied to
12 a particular entity, such as a user or business. A model is applied to an entity by
13 assigning values to the attributes of the model, at which point the attributes are
14 said to be bound. Each instance of an entity might have its own set of bound
15 attributes corresponding to the unbound attributes of a particular model. For
16 example, each user will have a set of bound attributes under one or more models.
17 Similarly, a given hyperlink target can be associated with a set of bound attributes
18 from a model or from certain schemata of the model. It is these bound attributes
19 that are used for searching in databases 36 and 58.

20 Each attribute in a schema has a name and associated type. An attribute is
21 typically referred to by its schema and its name. For example, an attribute having
22 the name *current_location* from the *user* schema might be of a type *location*,
23 consisting of a latitude and longitude pair, each of which are type *real*. This
24 attribute is referred to as *user.current_location*. When bound, it may take on the
25

1 value (47.6233, 122.3204), indicating a geographical location at latitude 47.6233
2 and longitude 122.3204.

3 In the preferred implementation of the invention, the reasoning part of a
4 model is implemented as one or more executable "rules." A rule is implemented
5 as an executable program or module as already discussed above. During
6 execution, a rule typically examines bound attributes and performs actions
7 depending on the values of the attributes. More specifically, a rule adds one or
8 more search predicates or limitations to a query, depending on a user's bound
9 attributes.

10 Various models can be registered on a user's computer. Such registration
11 can be performed at the user's direction, or automatically and dynamically by
12 different information providers as the user navigates from one information
13 provider to another. It may be desirable for hypermedia documents or hyperlinks
14 within such documents to specify pointers or URLs to models that are used by the
15 documents or hyperlinks. Upon encountering a new model, the user's computer
16 would automatically retrieve and register the model. Hypermedia documents and
17 hyperlinks might alternatively contain pointers or URLs to schemata used by the
18 documents and hyperlinks, for retrieval by the user's computer.

19 The computer stores these models and in many cases allows the user to
20 assign values to the attributes defined by the models. When a user assigns a value
21 to an attribute, that attribute is bound and is therefore placed in the user's list of
22 bound attributes. Similarly, a registered model might include or specify one or
23 more executable rules that make use of the attributes defined by the model. These
24 rules, or references to these rules, are placed in the rule base maintained by the
25 user's computer.

1 Fig. 3 shows a list of bound attributes 70 and a rule base 72. The list of
2 bound attributes is maintained by a user's computer and can change as the user
3 navigates from one hypermedia resource to another. In general, the list of bound
4 attributes is made up of three different lists: a list of "ambient" bound attributes 74,
5 a list of "context" bound attributes 76, and a list of "link" bound attributes 78. The
6 various attributes contained in these lists are defined by one or more schemata 80,
7 which are in turn used by one or more registered models 82.

8 The values for the list of ambient bound attributes come primarily from a
9 user profile 84. Such values might also be gathered automatically by an
10 application program. Ambient bound attributes generally remain constant as the
11 user navigates through different hypermedia documents. A user's current
12 geographic location is an example of an ambient bound attribute.

13 The values for the list of context bound attributes are specified in whatever
14 particular hypermedia document or resource 86 is currently activated. These
15 values are constant as long as the resource is activated, but change when the user
16 navigates to a different resource. As an example, a particular hypermedia
17 document that discusses Chinese food might set a "cuisine" attribute to "Chinese."

18 The values for the list of link bound attributes come from a particular soft
19 hyperlink 88 that the user has activated. These values are maintained only until
20 resolution of the soft hyperlink. For example, a soft hyperlink might specify a
21 maximum allowed commute time for a user to any restaurant selected through the
22 soft hyperlink.

23 Rule base 72 contains a plurality of rules and associated mandatory
24 attributes. The rules can be specified by any one of the registered models 82, in
25 which case they are referred to as "ambient" rules, or by a particular selected soft

1 hyperlink 88, in which case they are referred to as “link” rules. Ambient rules are
2 relatively constant, while link rules change upon selecting each new soft hyperlink.

3 To resolve a soft hyperlink such as soft hyperlink 88, the query builder
4 constructs a query formulation or object 90. Initially, the query object consists of a
5 partially-specified query formulation obtained from soft hyperlink 88. To add
6 limitations or search predicates to this query formulation, the rules of the rule base
7 are executed one by one, in turn. In the preferred implementation, each rule is
8 executed if and only if its mandatory attributes are bound in the list of current
9 bound attributes 70. During execution, a rule can read the values of attributes from
10 the bound attribute list 70. In addition, a rule can add bound attributes to the list of
11 context bound attributes 76. Depending on the values found in bound attribute list
12 70, the rule might or might not add an additional search predicate to query object
13 90.

14 The query builder steps through the rules of rule base 72. Since a rule has
15 the potential of changing bound attributes, one rule might cause the mandatory
16 attributes of another rule to become bound. Thus, the query builder passes through
17 the rules a number of times, until further passes do not result in any more rules
18 being executed. However, each rule is allowed to execute only once.

19 In practice, a rule specifies mandatory attributes and optional attributes.
20 These specified attributes are all of the attributes that will be used by the rule.
21 When a rule is executed or “fired,” it is passed three objects: the ambient bound
22 attribute list, the context attribute list, and the query object. The rule uses the
23 values of the mandatory attributes, as well as values from the ambient and context
24 bound attribute lists, to decide whether to add one or more query fragments to the
25

1 query object. The query object maintains the query fragments over the execution
2 of many rules.

3 The following is an example of a possible rule specified by the "world"
4 model:

5 World rule:

6 Requires:

7 user.curr_location_latitude
8 user.curr_location_longitude

9 Optional:

10 world.max_commute_time
11 world.avg_speed_mph
12 business.rank_with_distance
13 user.cost_commute_mile

14 Logic:

15 if world.max_commute_time and
16 world.avg_speed_mph are bound, then
17 add query predicate that
18 destination must be located within
19 commuting distance of user's
20 current location

21 if business.rank_with_distance is bound
22 and "true" and user.cost_commute_mile
23 is bound, then
24 add query rank expression that
25 ranks destination based on cost
to commute

18 This rule specifies mandatory attributes *user.curr_location_latitude* and
19 *user.curr_location_longitude*, and will therefore execute only if these attributes are
20 bound in the user's bound attribute list.

21 The rule specifies optional attributes *world.max_commute_time*,
22 *world.avg_speed_mph*, *business.rank_with_distance*, and
23 *user.cost_commute_mile*. During execution, the rule will add query
24 predicates depending on the values of these attributes.
25

1 The example gives a good example of attributes defined under a world
2 model: *world.max_commute_time* and *world.avg_speed_mph*. These are
3 attributes that might be set up to be constant for all users. The attribute
4 *user.cost_commute_mile*, on the other hand, represents the cost of
5 commuting one mile. The value of this attribute will vary from one user to
6 another.

7 In actual practice, a rule is compiled from a high-level language into an
8 executable, callable program module. It might be possible to actually embed the
9 rule in its soft hyperlink. However, it is more likely that rules will be stored on a
10 user's computer and specified in the hyperlink by some type of global identifier,
11 along with a pointer or URL to a location from where the actual executable code of
12 the rule can be obtained. With the global identifier, the user's computer can check
13 to see if it already has the rule, and, if not, can retrieve it from the location referred
14 to in the soft hyperlink.

15 Fig. 4 shows a system configuration 100 in accordance with the invention in
16 which a client 102 communicates with a plurality of information providers 104,
17 each providing its own target database 106 of available hyperlink targets and a
18 corresponding request handler 108. The various client components discussed with
19 reference to Figs. 1 and 2 are implemented in a Web browser application program
20 110 that executes on client 102.

21 In the configuration of Fig. 4, each client maintains a list of registered
22 information providers 112, along with the schemata they support. An information
23 provider is said to support a schema if its database is searchable in terms of the
24 attributes defined by the schema. Each client also maintains a list of registered
25

1 models 114 as already discussed with reference to Fig. 3. Web browser 110
2 includes service proxies 116 for each registered information provider.

3 Web browser 110 functions as described above to formulate a query for
4 submission to a database of available hyperlink targets. In this case, however, a
5 decision must be made as to which information provider or database is to perform
6 the query. This decision is made on the basis of the schemata supported by the
7 various available information providers and databases. Once the query is
8 formulated and ready for submission to one or more databases, Web browser 110
9 determines which attributes are specified in the query and to which schemata they
10 belong. It then identifies the registered information providers that support those
11 schemata, and submits the query to those information providers. In some cases, it
12 may be that no information provider supports all of the schemata used in the query,
13 in which case the query is submitted to the information provider that supports the
14 greatest number of the schemata used.

15 Fig. 5 shows preferred steps for specifying a soft hyperlink. The method
16 includes a step 200 of formulating a partial query formulation. In the preferred
17 embodiment, the query formulation is specified at least partially in terms of query
18 attributes and of values for said query attributes.

19 A step 202 comprises creating one or more executable rules. Each rule,
20 when executed, potentially examines a user's list of bound attributes. In response
21 to the values of the bound attributes, a rule might add values to the user's list of
22 bound attributes and might perform a step of adding search predicates to the query
23 formulation of step 200.

24 A step 204 comprises associating each executable rule with a set of
25 mandatory attributes that condition execution of the rule. A rule will not execute

1 unless all of its mandatory attributes are present in the user's list of bound
2 attributes.

3 A subsequent step 206 comprises embedding or specifying the partial query
4 formulation, the rules, the link attributes, and the mandatory attributes in a
5 hyperlink. This step also includes embedding or specifying link bound attributes
6 in the hyperlink, for eventual inclusion in the user's list of bound attributes.

7 Specifying this information in a hypermedia document is accomplished
8 using appropriate extensions to SGML. More specifically, the information is
9 specified as one or more parameters corresponding to appropriately defined SGML
10 tag attributes. A partial query formulation is actually specified as a list of attribute
11 name and value pairs. Link attributes are specified in a similar way, while
12 mandatory attributes are specified as a list of attribute names. Rules are preferably
13 specified by global identifiers, possibly accompanied by a URL to a location from
14 where the rules can be retrieved. Alternatively, there might be a central repository
15 from which any rule can be retrieved by referring to its global identifier.

16 Fig. 6 shows preferred steps for resolving a soft hyperlink such as one
17 specified in accordance with the steps of Fig. 5. A step 300 comprises maintaining
18 a plurality of databases of available hyperlink targets. Each such database is
19 searchable by means of one or more query attributes supported by the database and
20 relating to the available hyperlink targets. In the preferred embodiment, each
21 database supports one or more schemata, where each schema defines a plurality of
22 individual attributes by name and type.

23 A step 302 comprises maintaining a list of bound attributes in a user's
24 computer. Again, the names and types of these attributes are defined by one or
25 more schemata. The list of bound attributes includes ambient bound attributes that

1 are independent of any particular hypermedia content or selected hyperlink. A
2 user profile is one source of values for ambient bound attributes. The list of bound
3 attributes further includes link bound attributes that are specified in a selected
4 hyperlink, and context bound attributes that are specified in a particular current or
5 selected hypermedia document or resource.

6 A step 304 comprises maintaining a rule base of executable rules in the
7 user's computer. Each rule in the rule base is associated with a set of mandatory
8 attributes. Both ambient and link rules are maintained in the rule base. Ambient
9 rules are rules that are specified independently of any particular hyperlink. These
10 rules might be specified by a model that is registered on a user's computer. Link
11 rules, on the other hand, are rules that are specified by a currently-selected soft
12 hyperlink.

13 A further step 306 comprises maintaining a list of available databases and
14 of the schemata or query attributes supported by the respective databases. This list
15 is maintained on the user's computer.

16 A step 308 comprises reading a selected soft hyperlink from a hypermedia
17 document or resource. This step includes identifying and/or extracting a query
18 formulation, one or more executable rules (or the global identifiers of the rules)
19 and associated mandatory attributes, and one or more link bound attributes from
20 the selected hyperlink. These elements are specified in the hyperlink as described
21 above with reference to Fig. 5. The executable rules and associated mandatory
22 attributes are put into the rule base, and the link bound attributes are added to the
23 user's current bound attribute list.

24 A step 310 comprises executing the rules of the rule base to potentially add
25 search predicates to the query formulation originally obtained from the soft

1 hyperlink. This step comprises stepping through the rules of the rule base and
2 executing any rule whose mandatory attributes are in the user's list of bound
3 attributes. In the preferred embodiment, this step is repeated until no more rules
4 are executed by further repetitions. When this step is completed, the query will be
5 ready for submission to an appropriate database.

6 Step 312 comprises identifying one or more databases that support one or
7 more of the query attributes specified in the query formulation as modified by the
8 executable rules. More specifically, this step comprises determining which
9 schemata define the attributes specified in the modified query formulation, and
10 then examining the user's list of databases to determine which databases support
11 the schemata. Thus, the database or databases are selected depending on the
12 search predicates specified and added to the query formulation.

13 A further step 314 in accordance with the invention comprises querying the
14 identified database or databases with the modified query formulation to locate one
15 or more hyperlink targets having attributes and attribute values that satisfy the
16 query formulation. The query potentially locates one or more hyperlink targets.

17 A subsequent step 316 comprises activating one or more of the hyperlink
18 targets located in step 314. The activating step consists of opening, displaying, or
19 otherwise rendering the hypermedia resource targeted by the located hyperlink
20 target(s). If querying the identified database(s) locates a plurality of hyperlink
21 targets, the targets are listed in a conventional WWW format so that the user can
22 select one of the hyperlink targets for activation. If only a single target is located,
23 this target is activated immediately, without further user intervention.

24 The invention described above stresses transparency to the user, utilizing
25 data and modeling techniques to inform client-side and server-side queries against

1 a database of possible targets or destinations. Hyperlinks are resolved when they
2 are selected, rather than when they are authored. For example, an author of a
3 hypermedia document might include an "interesting sidebar about Chechnya" as a
4 hyperlink. The methods above can use knowledge of the user's age in determining
5 whether to jump to encyclopedia-like sources, children's titles, or dissertation-
6 level content.

7 In creating a hyperlink, the author provides only the minimum set of data
8 needed by the system to aid in resolving hyperlinks, such as a search predicate
9 indicating that the query should be limited to a particular topic like "restaurants."
10 The system itself combines this data with other information, gleaned
11 independently of the author, and formulates a query against a database of logical
12 targets or destinations. If the query is sufficiently determined, the result of the
13 query will return a single logical destination and the destination will be activated.
14 Otherwise, the user may be presented with a list of possible destinations from
15 which to choose.

16 The invention offers great flexibility to authors of hypermedia content. In
17 addition, its use will be of enormous benefit to end users by decreasing the
18 frustration that is so often associated with trying to locate specific types of
19 hypermedia.

20 In compliance with the statute, the invention has been described in language
21 more or less specific as to structural and methodical features. It is to be
22 understood, however, that the invention is not limited to the specific features
23 described, since the means herein disclosed comprise preferred forms of putting
24 the invention into effect. The invention is, therefore, claimed in any of its forms or
25

1 modifications within the proper scope of the appended claims appropriately
2 interpreted in accordance with the doctrine of equivalents.
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1 CLAIMS

2 1. A method of resolving a selected hyperlink, comprising the following
3 steps:

4 identifying a query formulation from the selected hyperlink;

5 querying a database of available hyperlink targets with the query
6 formulation to locate one or more hyperlink targets that satisfy the query
7 formulation.

8
9 2. A computer-readable storage medium containing instructions that are
10 executable to perform the steps of claim 1.

11
12 3. A method as recited in claim 1, further comprising a step of rendering
13 a hypermedia document specified by one of the located hyperlink targets.

14
15 4. A method as recited in claim 1, further comprising a step of selecting
16 the database from a plurality of databases depending on search predicates specified
17 in the query formulation.

18
19 5. A method as recited in claim 1, further comprising a step of adding
20 search predicates to the query formulation after identifying the query formulation
21 from the selected hyperlink.

22
23 6. A computer-readable storage medium containing instructions that are
24 executable to perform the steps of claim 5.

1 7. A method as recited in claim 1, further comprising:
2 maintaining a list of bound attributes that are independent of the selected
3 hyperlink;
4 adding search predicates to the query formulation based on said bound
5 attributes.

6
7 8. A method as recited in claim 1, further comprising:
8 maintaining a list of bound attributes that are independent of the selected
9 hyperlink, said bound attributes being based upon a user profile;
10 adding search predicates to the query formulation based on said bound
11 attributes.

12
13 9. A method as recited in claim 1, further comprising:
14 maintaining a list of bound attributes that are independent of the selected
15 hyperlink;
16 identifying one or more executable link rules from the selected hyperlink;
17 executing the link rules to add search predicates to the query formulation
18 depending on said bound attributes.

19
20 10. A method as recited in claim 1, further comprising:
21 maintaining a list of bound attributes that are independent of the selected
22 hyperlink;
23 identifying one or more executable link rules from the selected hyperlink;
24 executing the link rules to add search predicates to the query formulation
25 depending on said bound attributes;

1 selecting the database from a plurality of databases depending on search
2 predicates specified in and added to the query formulation.

3
4 11. A method of resolving a selected hyperlink, comprising the
5 following steps:

6 identifying a query formulation from the selected hyperlink, the query
7 formulation being specified at least partially in terms of query attributes and of
8 values for said query attributes;

9 identifying one or more databases that support one or more of the query
10 attributes specified in the query, the one or more databases being identified from a
11 plurality of databases of available hyperlink targets, each such database being
12 searchable by use of one or more query attributes supported by the database and
13 relating to the available hyperlink targets;

14 querying the identified databases with the query formulation to locate one
15 or more hyperlink targets having attributes and attribute values that satisfy the
16 query formulation.

17
18 12. A computer-readable storage medium containing instructions that
19 are executable to perform the steps of claim 11.

20
21 13. A method as recited in claim 11, further comprising:
22 maintaining a list of the databases and of the query attributes supported by
23 the respective databases;

1 the step of identifying one or more databases including examining the list of
2 the databases to identify one or more databases that support one or more of the
3 query attributes specified in the query formulation.
4

5 14. A method as recited in claim 11, wherein querying the one or more
6 databases locates a plurality of hyperlink targets, the method further comprising
7 listing the plurality of hyperlink targets so that a user can select one of the
8 hyperlink targets for activation.
9

10 15. A method as recited in claim 11, wherein querying the one or more
11 databases locates a single hyperlink target, the method further comprising
12 activating the single hyperlink target.
13

14 16. A method as recited in claim 11, further comprising:
15 maintaining a list of bound attributes that are independent of the selected
16 hyperlink;
17 adding search predicates to the query formulation based on said bound
18 attributes.
19

20 17. A method as recited in claim 11, further comprising:
21 maintaining a list of bound attributes that are based on a user profile;
22 adding search predicates to the query formulation based on said bound
23 attributes.
24
25

1 18. A method as recited in claim 11, further comprising:
2 maintaining a list of bound attributes comprising ambient bound attributes
3 that are independent of the selected hyperlink and link bound attributes that are
4 specified in the selected hyperlink;
5 adding search predicates to the query formulation based on said bound
6 attributes.

7
8 19. A method as recited in claim 11, further comprising:
9 maintaining a list of bound attributes comprising ambient bound attributes
10 that are independent of the selected hyperlink, context bound attributes that are
11 specified in a selected hypermedia document, and link bound attributes that are
12 specified in the selected hyperlink;
13 adding search predicates to the query formulation based on said bound
14 attributes.

15
16 20. A method as recited in claim 11, further comprising:
17 maintaining a list of bound attributes that are independent of the selected
18 hyperlink;
19 identifying one more executable link rules from the selected hyperlink;
20 executing the link rules to add search predicates to the query formulation
21 based on said bound attributes.

1 **21.** A method as recited in claim 11, further comprising:
2 defining a plurality of schemata, each schema defining a plurality of
3 attributes, wherein each database supports one or more schemata and their defined
4 attributes;
5 wherein the attributes used to specify the query formulation are defined by
6 one or more schemata;
7 the step of identifying one or more databases comprising identifying one or
8 more databases that support one or more of the schemata that define the attributes
9 used to specify the query formulation.
10

11 **22.** A computer-readable storage medium containing instructions that
12 are executable to perform the steps of claim 21.
13

14 **23.** A method of resolving a selected hyperlink, comprising the
15 following steps:

16 identifying a query formulation from the selected hyperlink;
17 maintaining a list of bound attributes;
18 identifying one or more executable link rules from the selected hyperlink,
19 wherein an identified link rule is associated with a set of mandatory attributes;
20 executing any particular link rule if and only if all of its mandatory
21 attributes are in the list of bound attributes, wherein executing a link rule
22 potentially adds search predicates to the query formulation depending on said
23 bound attributes;
24
25

1 querying a database of available hyperlink targets with the query
2 formulation to locate one or more hyperlink targets that satisfy the query
3 formulation.
4

5 24. A computer-readable storage medium containing instructions that
6 are executable to perform the steps of claim 23.
7

8 25. A method as recited in claim 23, the step of maintaining a list of
9 bound attributes comprising maintaining ambient bound attributes that are
10 independent of the selected hyperlink and link bound attributes that are specified
11 by the selected hyperlink.
12

13 26. A method as recited in claim 23, the step of maintaining a list of
14 bound attributes comprising maintaining ambient bound attributes that are
15 independent of the selected hyperlink, context bound attributes that are specified in
16 a selected hypermedia document, and link bound attributes that are specified by
17 the selected hyperlink.
18

19 27. A method as recited in claim 23, wherein executing a link rule
20 includes a step of examining the list of bound attributes to determine whether to
21 add a search predicate to the query formulation.
22

23 28. A method as recited in claim 23, wherein executing a link rule
24 potentially adds attributes to the bound attribute list.
25

1 29. A method as recited in claim 23, further comprising a step of
2 selecting the database from a plurality of databases depending on search predicates
3 specified in and added to the query formulation.
4

5 30. A method as recited in claim 23, further comprising a step of
6 executing ambient rules that are specified independently of the selected hyperlink.
7

8 31. A method of resolving a selected hyperlink, comprising the
9 following steps:

10 identifying a query formulation from the selected hyperlink;

11 maintaining a list of bound attributes;

12 maintaining a rule base of executable rules, wherein an executable rule is
13 associated with a set of mandatory attributes, and wherein executing a rule
14 potentially adds search predicates to the query formulation depending on the
15 bound attributes;

16 stepping through the rules of the rule base and executing any rule whose
17 mandatory attributes are in the list of bound attributes;

18 querying a database of available hyperlink targets with the query
19 formulation to locate one or more hyperlink targets that satisfy the query
20 formulation.
21

22 32. A computer-readable storage medium containing instructions that
23 are executable to perform the steps of claim 31.
24
25

1 33. A method as recited in claim 31, wherein maintaining the rule base
2 comprises maintaining ambient rules that are specified independently of the
3 selected hyperlink and link rules that are specified by the hyperlink.

4
5 34. A method as recited in claim 31, further comprising a step of
6 repeating the steps of stepping through the rules of the rule base and executing any
7 particular rule whose mandatory attributes are in the list of bound attributes.

8
9 35. A method as recited in claim 31, wherein executing a rule includes a
10 step of examining the list of bound attributes to determine whether to add a search
11 predicate to the query formulation.

12
13 36. A method as recited in claim 31, wherein executing a rule
14 potentially adds attributes to the bound attribute list, the method further comprising
15 a step of repeating the steps of stepping through the rules of the rule base and
16 executing any particular rule whose mandatory attributes are in the list of bound
17 attributes.

18
19 37. A method as recited in claim 31, the step of maintaining a list of
20 bound attributes comprising maintaining ambient bound attributes that are
21 independent of the selected hyperlink and link bound attributes that are specified in
22 the selected hyperlink.

1 **38.** A method as recited in claim 31, the step of maintaining a list of
2 bound attributes comprising maintaining ambient bound attributes that are
3 independent of the selected hyperlink, context bound attributes that are specified in
4 a selected hypermedia document, and link bound attributes that are specified in the
5 selected hyperlink.

6
7 **39.** A method as recited in claim 31, further comprising a step of
8 selecting the database from a plurality of databases depending on search predicates
9 specified in and added to the query formulation.

10
11 **40.** A method as recited in claim 31, wherein:
12 the step of maintaining the rule base comprises maintaining ambient rules
13 that are specified independently of the selected hyperlink and link rules that are
14 specified by the hyperlink;
15 the step of maintaining a list of bound attributes comprising maintaining
16 ambient bound attributes that are independent of the selected hyperlink and link
17 bound attributes that are specified by the selected hyperlink;
18 executing a rule includes a step of examining the list of bound attributes to
19 determine whether to add a search predicate to the query formulation;
20 executing a rule potentially adds attributes to the bound attribute list;
21 the method further comprises selecting the database from a plurality of
22 databases depending on search predicates specified in and added to the query
23 formulation.
24
25

1 **41.** A method of specifying a hyperlink, comprising the following steps:
2 specifying a query formulation in the hyperlink;
3 specifying one or more executable rules in the hyperlink.
4

5 **42.** A method as recited in claim 41, further comprising a step of
6 specifying the query formulation at least partially in terms of query attributes and
7 of values for said query attributes.
8

9 **43.** A method as recited in claim 41, further comprising associating each
10 of the executable rules with a set of mandatory attributes.
11

12 **44.** A method as recited in claim 41, wherein the executable rules, when
13 executed, potentially perform a step of adding search predicates to the query
14 formulation.
15

16 **45.** A method as recited in claim 41, wherein the executable rules, when
17 executed, perform the following steps:
18 examining a list of bound attributes;
19 adding a search predicate to the query formulation depending on the bound
20 attributes.
21

22 **46.** A method as recited in claim 41, wherein the executable rules, when
23 executed, potentially perform a step of adding attributes to a list of bound
24 attributes.
25

1 **47.** A method as recited in claim 41, further comprising a step of
2 specifying bound attributes in the hyperlink for inclusion in a list of bound
3 attributes.

4
5 **48.** A method as recited in claim 41, further comprising:
6 specifying bound attributes in the hyperlink for inclusion in a list of bound
7 attributes;

8 wherein the executable rules, when executed, perform steps of examining
9 the list of bound attributes and of adding a search predicate to the query
10 formulation depending on the bound attributes.

11
12 **49.** A computer-readable storage medium containing a hypermedia file,
13 the hypermedia file comprising:

14 informational content for rendering to a user;

15 a hyperlink that can be activated by the user when the informational content
16 is rendered;

17 the hyperlink specifying a query formulation that can be submitted to a
18 database for resolution of the hyperlink.

19
20 **50.** A computer-readable storage medium as recited in claim 49 wherein
21 the query formulation is specified at least partially in terms of query attributes and
22 of values for said query attributes.

1 51. A computer-readable storage medium as recited in claim 49, the
2 hyperlink further specifying one or more executable rules, said rules being
3 executable to potentially add query predicates to the query formulation:
4

5 52. A computer-readable storage medium as recited in claim 49, the
6 hyperlink further specifying one or more executable rules, the rules being
7 respectively associated with sets of mandatory attributes, said rules being
8 executable to potentially add query predicates to the query formulation depending
9 on whether the mandatory attributes are bound.
10

11 53. A computer-readable storage medium as recited in claim 49, the
12 hyperlink further specifying one or more executable rules, said rules being
13 executable to examine a list of bound attributes and to add query predicates to the
14 query formulation depending on said examination of the list of bound attributes.
15

16 54. A computer-readable storage medium as recited in claim 49, the
17 hyperlink further specifying one or more executable rules, said rules being
18 executable to potentially add attributes to a list of bound attributes.
19

20 55. A computer-readable storage medium as recited in claim 49, the
21 hyperlink further specifying bound attributes for inclusion in a list of bound
22 attributes.
23
24
25

1 56. A computer-readable storage medium as recited in claim 49,
2 wherein the hyperlink further specifies:

3 one or more executable rules associated respectively with sets of mandatory
4 attributes;

5 one or more bound attributes for inclusion in a list of bound attributes;

6 the rules being executable to examine the list of bound attributes and to
7 potentially add query predicates to the query formulation depending on said
8 examination of the list of bound attributes.

9
10 57. A hypermedia-based navigation system comprising:

11 an information provider that provides a hypermedia document, the
12 hypermedia document having at least one hyperlink, said hyperlink specifying a
13 query formulation that is specified at least partially in terms of query attributes and
14 of values for said query attributes;

15 a client configured to resolve the hyperlink by querying one or more
16 databases with the query formulation to locate one or more hyperlink targets
17 having attributes and attribute values that satisfy the query formulation.

18
19 58. A hypermedia-based navigation system comprising:

20 a plurality of databases of available hyperlink targets, each such database
21 being searchable by means of one or more query attributes supported by the
22 database and relating to the available hyperlink targets;

23 an information provider that provides a hypermedia document, the
24 hypermedia document having at least one hyperlink, said hyperlink specifying a
25

1 query formulation that is specified at least partially in terms of query attributes and
2 of values for said query attributes;

3 a client configured to resolve the hyperlink by querying at least one of the
4 databases with the query formulation to locate one or more hyperlink targets
5 having attributes and attribute values that satisfy the query formulation.

6
7 **59.** A hypermedia-based navigation system as recited in claim 58,
8 wherein the client is further configured to activate said one or more hyperlink
9 targets.

10
11 **60.** A hypermedia-based navigation system as recited in claim 58,
12 wherein the hyperlink specifies one or more executable rules for potentially adding
13 search predicates to the query formulation.

14
15 **61.** A hypermedia-based navigation system as recited in claim 58,
16 further comprising a list of bound attributes maintained by the client, wherein the
17 hyperlink specifies one or more executable rules for potentially adding search
18 predicates to the query formulation depending on said bound attributes.

19
20 **62.** A hypermedia-based navigation system as recited in claim 58,
21 further comprising a list of bound attributes maintained by the client, said bound
22 attributes being based on a user profile, wherein the hyperlink specifies one or
23 more executable rules for potentially adding search predicates to the query
24 formulation depending on said bound attributes.

1 63. A hypermedia-based navigation system as recited in claim 58,
2 wherein the client is configured to identify one or more of the databases that
3 support one or more of the query attributes specified in the query, and to resolve
4 the hyperlink by querying at least one of the identified databases with the query
5 formulation.

6
7 64. A hypermedia-based navigation system as recited in claim 58,
8 wherein the client is configured to maintain a rule base of executable rules for
9 potentially adding search predicates to the query formulation, said executable rules
10 including ambient rules that are specified independently of the selected hyperlink
11 and link rules that are specified by the hyperlink.

12
13 65. A hypermedia-based navigation system as recited in claim 58,
14 further comprising a list of bound attributes maintained by the client, said list of
15 bound attributes including ambient bound attributes that are independent of the
16 selected hyperlink and link bound attributes that are specified in the selected
17 hyperlink.

18
19 66. A hypermedia-based navigation system as recited in claim 58,
20 further comprising a list of bound attributes maintained by the client, said list of
21 bound attributes including ambient bound attributes that are independent of the
22 selected hyperlink, context bound attributes that are specified in a selected
23 hypermedia document, and link bound attributes that are specified in the selected
24 hyperlink.
25

1 67. A method of navigating hypermedia documents comprising the
2 following steps:

3 displaying at least one soft hyperlink to a user;

4 in response to the user activating said soft hyperlink, performing a query for
5 one or more hypermedia targets, said query being based at least in part upon
6 attributes associated with the user;

7 as a result of the query, displaying hyperlinks to said one or more
8 hypermedia targets.

9
10 68. A method as recited in claim 67, further comprising identifying said
11 attributes without requesting search limitations from the user.

12
13 69. A method as recited in claim 67, wherein the step of displaying
14 hyperlinks comprises displaying hard hyperlinks to said one or more hypermedia
15 targets.

16 70. A method as recited in claim 67, wherein the query is further based
17 upon attributes specified in the soft hyperlink.

18
19 71. A method as recited in claim 67, further comprising displaying a
20 hypermedia document to the user, the hypermedia document including said at least
21 one soft hyperlink, wherein the query is further based upon attributes specified in
22 the hypermedia document.

1 72. A method as recited in claim 67, further comprising displaying a
2 hypermedia document to the user, the hypermedia document including said at least
3 one soft hyperlink, wherein the query is further based upon attributes specified in
4 the hypermedia document and upon attributes specified in the soft hyperlink.
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Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

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Other: On-line: WPI, INSPEC, JAPIO, COMPUTER, CMP COMPUTER FULL TEXT

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	EP 0718784 A1 (SUN).	-
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X	DeRose S J & Durand D G, "Making Hypermedia Work, A User's Guide to HyTime", 1994, Dordrecht: Kluwer Academic Publishers, p 119, "7.4.2 Query Links".	41, 42 49, 50
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X Document indicating lack of novelty or inventive step
Y Document indicating lack of inventive step if combined with one or more other documents of same category.

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A Document indicating technological background and/or state of the art.
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E Patent document published on or after, but with priority date earlier than, the filing date of this application.